04-04-00

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April 3, 2000

Commissioner of Patents and Trademarks
Box Patent Application
Washington, DC 20231

Re: U.S. Patent Application
Inventor: Hisatoshi Hirota
Title: *Capacity Controller of Capacity Variable Compressor*
Priority: Japanese Application No. Hei 11-113035; Filed April 21, 1999
Our File: 133.046

Dear Sir:

Enclosed is a United States patent application which includes 7 pages of specification, 9 claims, Abstract of the Disclosure, 7 sheets of drawings, and an unexecuted Declaration. The executed Declaration and surcharge for late-filing of the Declaration, the filing fee, and an Assignment will be filed at a later date.

The following documents are also enclosed:

1) Preliminary Amendment, entry of which is requested before calculating the filing fee.
2) Certified copy of Japanese application No. Hei 11-113035, filed April 21, 1999, for the purpose of claiming its priority.

Respectfully submitted,

James E. Nilles

James E. Nilles
Registration No. 16,663

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Enclosures

Certification Under 37 CFR 1.10

Express Mail Label No: EL516557360US

Date of Deposit: April 3, 2000

I hereby certify that this paper or fee is being deposited with the United States Postal Service in "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Diane Schwaiger

Diane Schwaiger

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: Hisatoshi Hirota

Title: CAPACITY CONTROLLER OF CAPACITY VARIABLE COMPRESSOR

Priority: Japanese Application No. Hei 11-113035
Filed 21 April 1999

PRELIMINARY AMENDMENT

Box Patent Application
Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

This Preliminary Amendment is directed to a new U.S. application as identified above. Please enter this preliminary amendment prior to calculating the fees.

Please amend the application as follows:

IN THE SPECIFICATION

Page 1, cancel "DESCRIPTION" and substitute the title of the invention -- CAPACITY CONTROLLER OF CAPACITY VARIABLE COMPRESSOR --;

after the title insert the heading -- BACKGROUND OF THE INVENTION --; and the subheading -- 1. Field of the Invention --;

between lines 4 and 5, insert the subheading -- 2. Description of the Related Art --;

between lines 18 and 19, insert the heading -- OBJECTS AND SUMMARY OF THE INVENTION --;

cancel lines 24 and 25;

Page 2, between lines 12 and 13, insert the heading -- BRIEF DESCRIPTION OF THE DRAWINGS --;

Page 3, between lines 3 and 4, insert the heading -- DESCRIPTION OF THE PREFERRED EMBODIMENTS --.

IN THE CLAIMS

Claims 6 and 7, line 1, cancel "or 5";

IN THE ABSTRACT

Page 13, line 4, cancel "Said" and substitute -- The --;

cancel line 6 "(Fig. 1)".

REMARKS

This application has been amended to insert headings in the specification, to eliminate the multiple dependencies in the claims, and to conform the Abstract in accordance with preferred U.S. Patent Office practice. Entry of the amendments and early consideration and allowance are respectfully requested.

Respectfully submitted,

James E. Nilles

Dated: April 3, 2000

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Registration No. 16,663

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DESCRIPTION

The present invention relates to a capacity controller of a compressor with variable capacity used for a refrigerating cycle of an automobile air conditioner or the like, in accordance with the preamble part of claim 1, claim 4, claim 5, and to a method according to the preamble part of claim 8 and claim 9.

As the compressor in a refrigerating cycle of an automobile air conditioner directly is driven by the engine of the automobile the speed of the compressor cannot be controlled individually. In order to obtain proper refrigerating abilities without being limited by the engine speed compressors with variable capacity are used allowing to vary their capacity (the amount of discharged refrigerant) upon cooling or heating demand independent from the speed of the engine. The compressor may be a rotary compressor, a scroll compressor or a swash plate compressor. The capacity is controlled by controlling the inhalation pressure with the help of an energisation force brought onto a diaphragm by an electromagnetic solenoid. Due to said diaphragm also the pressure of the ambient air is applied. A capacity variation mechanism is controlled by the inhalation pressure. A capacity control mechanism having said diaphragm is complicated to operate, because the structure of the control mechanism is complicated and large in size, and because the available control range of the inhalation pressure is restricted. As a consequence, it is difficult, to control the compressor properly within a wide range of conditions.

It is an object of the present invention to provide a capacity control apparatus of a compressor with variable capacity which can be of compact size and structurally simple and which allows to obtain wide control range, and to propose a method for controlling the capacity of the compressor properly within a broader control range compared with the useable control range of only the inhalation pressure.

Said task is achieved with the features contained in claim 1, with the feature combination of claim 4 or claim 5, and by the method as disclosed in claims 8 or 9.

According to the invention a wide control range is obtained with a compact and small sized control apparatus having a simple configuration. This is achieved by controlling the capacity of the compressor with the help of a differential pressure added to the

inhalation pressure on an arbitrary level with the help of a controlling piston valve body, loaded inter alia by a solenoid. Additionally, the inhalation pressure is applied to the piston valve body so that a value of the differential pressure can be maintained and set arbitrary for the transmission into the capacity variation mechanism to correspondingly adjust the capacity of the compressor. Basically, the differential pressure used in connection with the inhalation pressure is derived from a discharge pressure of the compressor allowing to broaden the pressure variation range for the capacity variation mechanism. The inhalation pressure remains the leading control parameter. However, not only the inhalation pressure and/or its pressure variations control the capacity variation mechanism, but in addition an assistant differential pressure is taken from the discharge pressure of the compressor and is added. The magnitude of the differential pressure may be adjusted and varied by a solenoid, e.g. a proportional solenoid

Embodiments of the invention will be described with the help of the drawings. In the drawings is:

Fig. 1 sectional views of a capacity controller, a capacity variation mechanism and a rotary compressor integrated into a refrigerating cycle of an automobile air conditioning system,

Fig. 2 a partial cross-section of the compressor shown in Fig. 1,

Fig. 3 a partial cross-section of a detail of the compressor of Fig. 1,

Fig. 4 a schematic view of the capacity variation mechanism of Fig. 1,

Fig. 5 a view similar to Fig. 1, representing the condition of an adjustment of maximum capacity of the compressor,

Fig. 6 a view similar to Fig. 1, representing a condition of minimum capacity of the compressor,

Fig. 7 a diagram representing the control behaviour of the capacity control apparatus as used in Fig. 1, showing the value of a

differential pressure over the capacity duty of the compressor, and

Fig. 8 a view similar to Fig. 1 containing a second embodiment of a capacity control apparatus.

Figs 1 to 8 show a rotary compressor 10 with variable capacity in conjunction with a capacity controller 20 and a capacity variation mechanism 30, together employed in a refrigerating cycle of an automobile air conditioner or the like. The compressor 10 has (Fig. 2) a circular housing 11 receiving a somewhat smaller circular rotor 12 disposed on an eccentric axis 13. Said rotor 12 is driven e.g. by the engine of the automobile (not shown). In the outer periphery of rotor 12 radially displaceable seal pieces 14 are biased outwardly by spring means such that they contact the inner surface of housing 11. At the closest position between the inner surface of housing 11 and periphery of rotor 12 a discharge port 19 is provided discharging compressed high pressure refrigerant into a discharge pressure duct 2. An inhalation duct 1 for low-pressure refrigerant supplied from an evaporator (not shown) communicates with an inhalation port 15a of an inhalation port control board 15. Port 15a allows to supply the low-pressure refrigerant into a compression chamber 18 of compressor 10. Board 15 has axial and oversized bore 16 for eccentric axis 13.

The capacity of the compressor 10 can be varied by increasing or decreasing the volume, i.e. the angular extension, of compression chamber 18, e.g. by rotating the inhalation control board 15 in order to displace the inhalation port 15a in rotary direction. Control board 15 has a protruding driving pin 17 which can be adjusted about the axis of board 15 by capacity variation mechanism 30.

Mechanism 30 in Fig. 4 controls the position of the driving pin 17 in order to control the rotary orientation of the inhalation port 15a of control board. In a cylinder 31 of mechanism 30 a piston 32 is moveable in axial direction. Driving pin 17 engages into a circumferential groove 32a of piston 32. An axial movement of piston 32 automatically displaces control board 15 about its axis. Piston 32 is loaded by a spring 32 in a direction adjusting the capacity of the compressor towards a minimum. Spring 32 is received within one part of cylinder 31. Said part of cylinder 31 is also connected to inhalation duct 1 such that the pressure inside said part of the cylinder 31 corresponds

an inhalation pressure Ps of the compressor. The opposite part of cylinder 31 (at the other side of piston 32) is connected to a differential pressure port 28c of said capacity controller 20 which operates as a differential pressure controller. The pressure within the other part of cylinder 31 is a control pressure Pc the value of which is controlled by said controller 20. The higher said control pressure Pc is, the further piston 32 is displaced counter to spring 32 and the more control board 15 is rotated towards its position for maximum capacity of the compressor. The lower said control pressure Pc is, the more control board 15 rotated by spring 32 and inhalation pressure Ps towards its position of minimum capacity of the compressor 10.

Capacity controller 20, e.g. of Fig. 1, is a fixed differential pressure valve and includes a solenoid (coil 21, fixed iron core 22 and moveable iron core 23) for controlling said differential pressure also by the pressures at both ends of a piston valve body 25. The driving source of said solenoid is electromagnetic coil 21 to which electric current can be supplied upon demand (proportional solenoid, the actuation force of which directly is proportional to the value of current supplied to coil 21).

In addition springs 26, 27 are provided which act in opposite directions onto said piston valve body 25. The setting of both springs 26, 27 determines in the embodiment of Fig. 1 a basic maximum value of the differential pressure (Pc - Ps). Said value, however, can arbitrarily be decreased by feeding current into coil 21. Moveable iron core 23 is attracted the more by fixed iron 22, the stronger the current is. Moveable iron core 23 causes a thrust F which is transmitted to said piston valve body 25 via a rod 24 extending along the axis of fixed iron core 20. Thrust F is acting in opening direction of said differential pressure valve of said controller 20 in Fig. 1..

Said inhalation duct 1 is connected to an inhalation pressure port 28s provided in a side of a housing of controller 20 and behind the back or rear effective pressure area of piston valve body 25 which can be loaded in the same direction by the thrust F of moveable iron core 23.

Piston valve body 25 co-operates by a front end valve closure jaw part 25a with a valve seat 42 provided between a space 41 housing piston valve body 25 and axially disposed

differential pressure port 28c. Differential pressure port 28c of controller 20 is connected to said other part of cylinder 31 on the side of piston 32 opposite to spring 33.

As a consequence, said control pressure Pc when controlled corresponds to the inhalation pressure Ps but is higher by an increment of pressure due to the thrust F caused by moveable iron core 23 (and the setting of springs 26, 27).

Discharge pressure duct 2 is connected to a discharge pressure port 28d of controller 20. Discharge pressure port 20d (discharge pressure Pd) opens in the vicinity of valve seat 42 at the circumferential side of piston valve body 25, so that discharge pressure Pd does not affect the piston valve body 25 in axial direction, i.e., piston valve body 25 is pressure balanced for discharge pressure Pd.

Said valve closure jaw part 25a formed at the front end of piston valve body 25 serves to open and close said valve seat 42 between discharge pressure port 28d and differential pressure port 28c. As soon as said valve jaw part 25a is lifted from valve seat 42 during a movement of piston valve body 25 with thrust F pressure Pd from discharge pressure duct 2 is transmitted via the open valve seat 42 into differential pressure port 28c, according to the initial control condition of the controller.

Whenever the value of the pressure at the differential pressure port 28c becomes lower than the fixed value of control pressure Pc, piston valve body 25 is moved towards its opening state such that a communication is established between the discharge pressure port 28d and differential pressure port 28c. As soon as then the value of the pressure at the differential pressure port 28c reaches the fixed value of the control pressure Pc, piston valve body 25 returns into its closing state and again separates said differential pressure port 28c from said discharge pressure port 28d.

Furthermore, e.g. outside of controller 20, differential pressure port 28c and inhalation pressure port 28s are directly interconnected via a leak passage 40 having a small cross-sectional area, e.g. provided in a connection between inhalation duct 1 and a duct connecting differential pressure port 28c with mechanism 30. As soon as valve closure jaw part 25a closes valve seat 42 the value of the pressure at the differential pressure port 28c is allowed to little by little relieve via leak passage 40 into inhalation duct 1. As

a result, piston valve body 25 always axially and slightly moves and control pressure Pc is controlled to the fixed value, e.g. corresponding to the value of the electric current supplied to electromagnetic coil 21.

As shown in Fig. 5 the larger the value of the electric current in electromagnetic coil 21 is, the larger the pressure differential of (Pc - Ps) becomes, and the angular position of the inhalation port 15a is displaced in a direction towards (max) by capacity variation mechanism 30. As a result the capacity of the inhalation compression chamber 18 and consequently the discharge pressure Pd increase.

The smaller the value of the electric current in electromagnetic coil 21 is, the smaller is the differential pressure of (Pc - Ps), as shown in Fig. 6 and the angular position of inhalation port 15a is adjusted in the direction towards (min) by capacity variation mechanism 30. As a result, the capacity of said inhalation compression chamber 18 and the discharge pressure Pb both decrease.

As can be seen in Fig. 7 the capacity of compression chamber 18 of compressor 10 is varied corresponding to the differential pressure Pc - Ps by controlling the value of the electric current in electromagnetic coil 21.

The value of the electric current in electromagnetic coil 21 is controlled by inputting detected signals from an engine sensor, temperature sensors inside and outside of an automobile compartment, an evaporator sensor and a plurality of other sensors detecting specific kinds of conditions. Said signals are input into a control part 3 containing a CPU and the like. Said CPU processes the input signals and provides an output signal based on the respective operation results. The control signal is then output from control part 3 to electromagnetic coil 21, e.g. via a not shown driving circuit.

In a second embodiment of controller 20 shown in Fig. 8 piston valve body 25 is co-operating with valve seat 42' such that said valve seat 42' is closed by the front end closure part 25a' in the direction of thrust F generated by solenoid 21, 22, 23. In this embodiment discharge pressure port 28d is omitted. At the very same location instead inhalation pressure port 28s is provided. Discharge pressure duct 2 directly is connected via leak passage 40 to the duct connecting differential pressure port 28c to

the left part of cylinder 31 of mechanism 30. Inhalation pressure port 28s of the embodiment of Fig. 1 is omitted. Inhalation pressure Ps can act on piston valve body 25 in the same direction as thrust F, namely towards the closing state. The pressure in differential pressure port 28c is acting in opening direction.

Springs 26, 27 determine a basic value of differential pressure Pc - Ps. Said value can be increased arbitrarily by increasing the value of the current supplied to electromagnetic coil 21.

As soon as due to pressure passing leak passage 40 the pressure at differential pressure port 28c rises beyond the fixed value of the control pressure Pc, piston valve body 25 is lifted from its valve seat 42'. A flow communication is established between differential pressure port 28c and inhalation pressure port 28s. Control pressure Pc drops to the fixed value . As soon as the pressure at the differential pressure port 28c has reached the fixed value of the control pressure Pc, piston valve body 25 returns again into its closed state. Again high pressure refrigerant passes through leak passage 40 to differential pressure port 28c in order to maintain the fixed value of the differential pressure Pc - Ps as adjusted by the value of the current for the coil 21.

In both embodiments high pressure refrigerant from the discharge pressure duct 2 is used to build up the fixed pressure value for the control pressure Pc, however, influenced by the initial value of the inhalation pressure Ps.

The invention instead may be applied to control the capacity of a scroll compressor or the like instead of a rotary compressor 10 as shown.

CLAIMS

1. A capacity controller of a compressor with variable capacity, **characterised by** controlling the capacity of said compressor by causing a differential pressure to an inhalation pressure of said compressor on an arbitrary level by a piston valve body onto which force adjusted by a solenoid and said inhalation pressure are applied, and by using said differential pressure in the capacity varying mechanism of said compressor to vary the capacity of said compressor.

2. Capacity controller as in claim 1, wherein when pressure within a housing space movably receiving said piston valve body of said controller is acting on said piston body in a direction opposite to said inhalation pressure falls below a fixed pressure said differential pressure is added to said inhalation pressure and said piston valve body is moved in opening direction such that said space communicates with a discharge pressure duct of said compressor and said pressure within said space is maintained at said fixed pressure corresponding to the sum of said differential pressure and said inhalation pressure.

3. Capacity controller as in claim 1, wherein when pressure within a housing space receiving said moveable piston valve body of said controller acts on said piston valve body in a direction opposite to said inhalation pressure exceeds the sum of said differential pressure and said inhalation pressure, said piston valve body is moved in opening direction such that said space communicates with an inhalation pressure duct of said compressor and said pressure within said space is maintained at

the fixed pressured corresponding to the sum of said differential pressure and said inhalation pressure.

4. Capacity controller of a compressor with variable capacity, comprising a pressure controlled capacity variation mechanism at said compressor and a solenoid actuated capacity controller, said controller generating a variable control pressure for said mechanism on the basis of the initial value of an inhalation pressure of said compressor, wherein said controller comprises a fixed pressure differential valve consisting of a valve seat and a piston valve body with a front end valve closure jaw part axially moveable in a space between opening and closing states in relation to said valve seat,

said space having an axial differential pressure port adjacent to said valve seat,

a sidewardly located discharge pressure port adjacent to said valve seat,

and rear inhalation pressure port communicating with the rear end of said space via a rear pressure effective surface of said piston valve body is situated,

said piston valve body being loaded by pressure in said differential pressure port in a first axial direction towards said closing state and by pressure at said inhalation pressure port in a second direction towards said opening state,

said differential pressure port being connected to a control pressure cylinder part of a cylinder of said mechanism such that increasing pressure at said differential pressure port adjusts said compressor capacity towards a maximum,

said discharge pressure port being connected to a discharge duct of said compressor,

said inhalation pressure port being connected to an inhalation port of said mechanism,

said differential pressure port and said inhalation pressure port being directly interconnected via a leak passage,

and wherein said piston valve body additionally is acted in a direction towards the opening state by a thrust generated by said solenoid, when supplied with a current, the value of which determines the value of a differential pressure between said control pressure and said inhalation pressure at said differential pressure port.

5. A capacity controller of a compressor with variable capacity, comprising a pressure controlled capacity variation mechanism at said compressor and a solenoid actuated capacity controller, said controller generating a variable control pressure for said mechanism on the basis of the value of an inhalation pressure of said compressor,

wherein said controller comprises a fixed pressure differential valve consisting of a valve seat and a piston valve body with a front end valve closure part axially moveable in a space of said controller in relation to said valve seat between opening and closing states,

said space having an axial differential pressure port and a sidewardly located inhalation pressure port adjacent to said valve seat, said piston valve body being acted by the pressure at

said differential pressure port in a direction towards the opening state and by the pressure at said inhalation pressure port in a direction towards said closing state,

said differential pressure port being connected to a control pressure cylinder part of a cylinder of said mechanism such that increasing pressure at said differential pressure port adjusts said compressor capacity towards a maximum,

said inhalation pressure port being connected to an inhalation pressure duct of said compressor

said differential pressure port in parallel being connected via a leak passage to discharge duct of said compressor,

said piston valve body in addition being acted upon in a direction towards said closing state by a thrust of a solenoid to which a current is supplied, the value of which determines the value of a differential pressure between the control pressure and said inhalation pressure at said differential pressure port.

6. Capacity controller as in claim 4 or 5, wherein said fixed differential pressure is the higher the higher the value of said current is.

7. Capacity controller as in claim 4 or 5, wherein the adjustable range of pressure variations at said differential pressure port is wider than the range of pressure variation at said inhalation pressure port.

8. A method to control the capacity of a compressor with variable capacity by a pressure controlled capacity variation mechanism and a solenoid actuated capacity controller, said controller

generating a variable control pressure for said mechanism corresponding to variations of an inhalation pressure of said compressor, wherein an expanded variation range of a differential pressure between said control pressure actuating said mechanism and said inhalation pressure of said compressor is controlled by the value of a current supplied to the solenoid of said controller, and wherein an initial value of said differential pressure is maintained by relieving a part of said control pressure via said controller to a low pressure inhalation duct of said compressor and by superimposing a predetermined pressure adding throttling function between said mechanism and a discharge duct of said compressor.

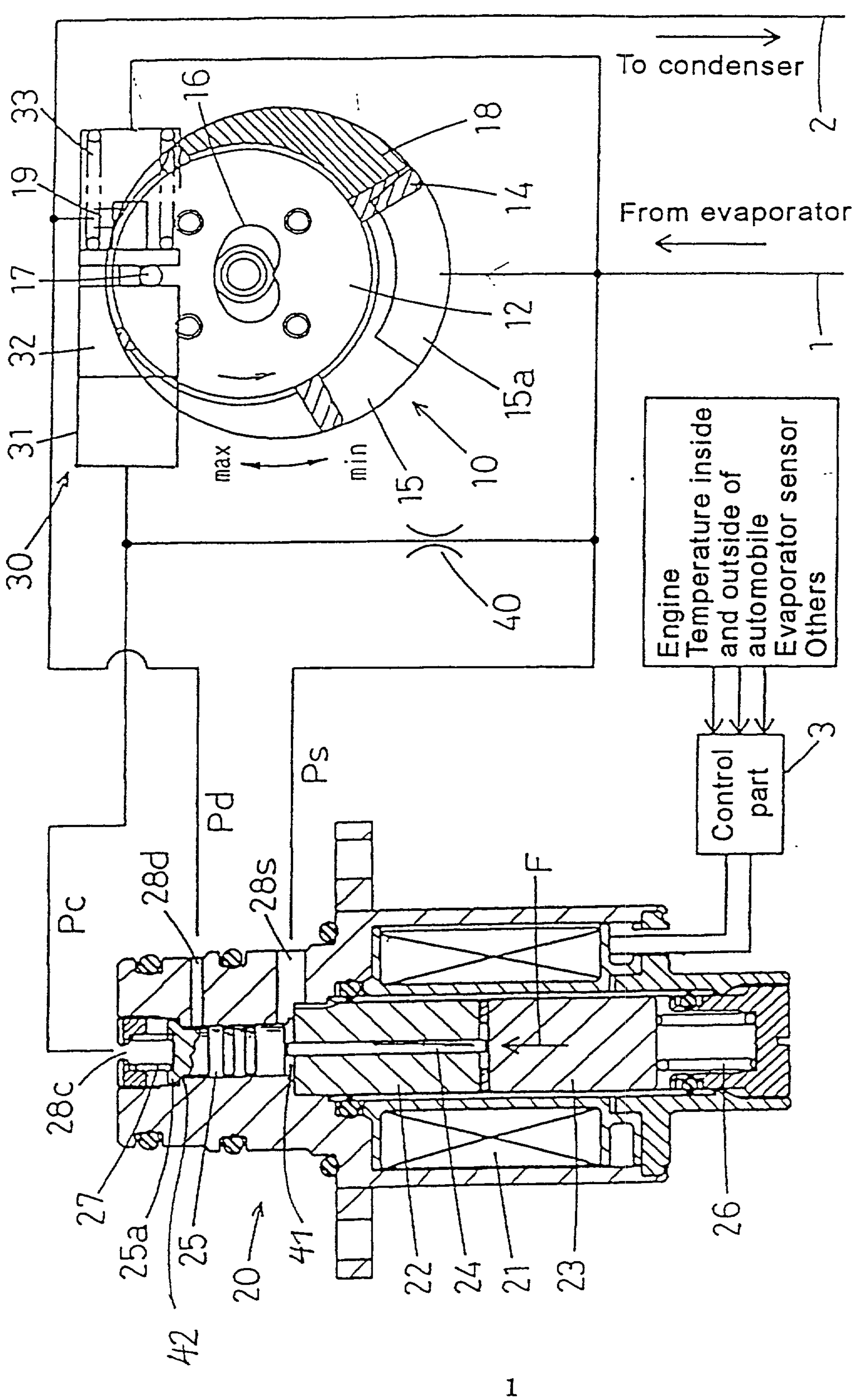
9. A method to control the capacity of compressor with variable capacity by a pressure controlled capacity variation mechanism and a solenoid actuated capacity controller said controller generating a variable control pressure for said mechanism corresponding to variations of an inhalation pressure of said compressor,

wherein an expanded variation range of a differential pressure between said control pressure actuating said mechanism and said inhalation pressure of said compressor is controlled by the value of a current supplied to the solenoid of said controller, and wherein an initial value of said differential pressure is maintained by adding pressure of high pressure refrigerant of a discharge pressure duct of said compressor via said controller to said control pressure and by permanently superimposing a predetermined pressure relieving throttling function between said mechanism and a low pressure inhalation duct of said compressor.

ABSTRACT

A small sized and structurally simple capacity controller having a wide control range of a compressor with variable capacity adds a differential pressure to an inhalation pressure on an arbitrary level by a piston valve body actuated by a solenoid and by the inhalation pressure. Said differential pressure is transmitted into a capacity variation mechanism of the compressor in order to change the capacity of the compressor.

(Fig. 1)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From evaporator
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Temperature inside and outside of automobile
Evaporator sensor
Others
Control part
max
min
Pc
Pd
Ps
F

FIG 1

FIG 2

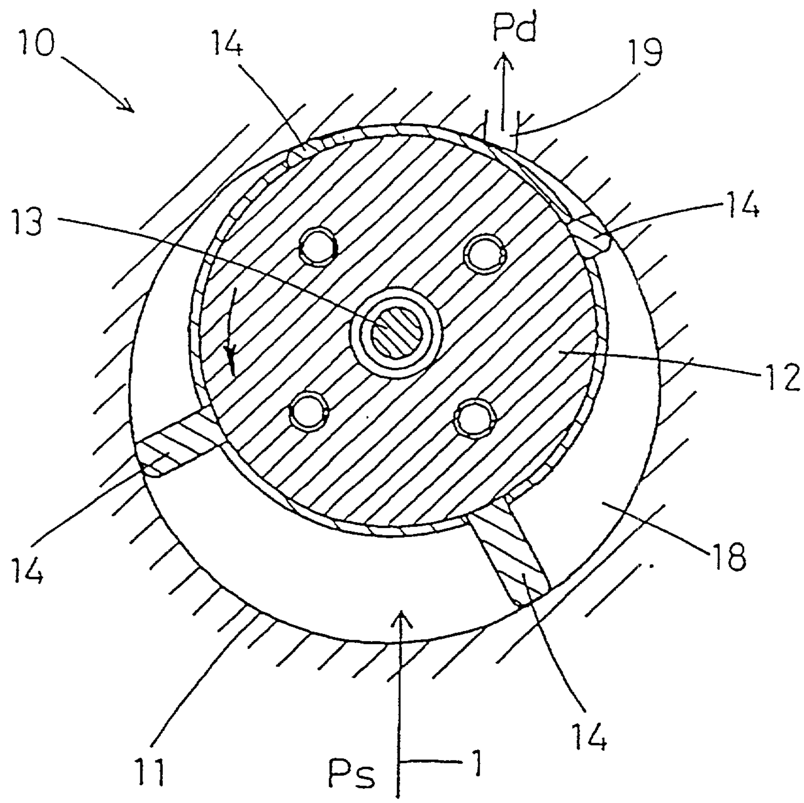


FIG 3

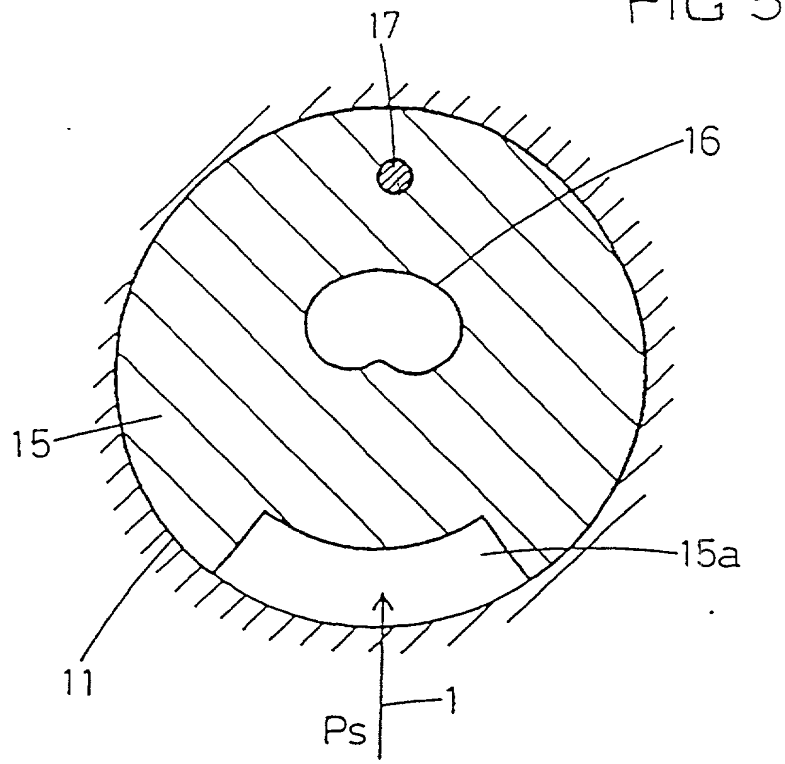
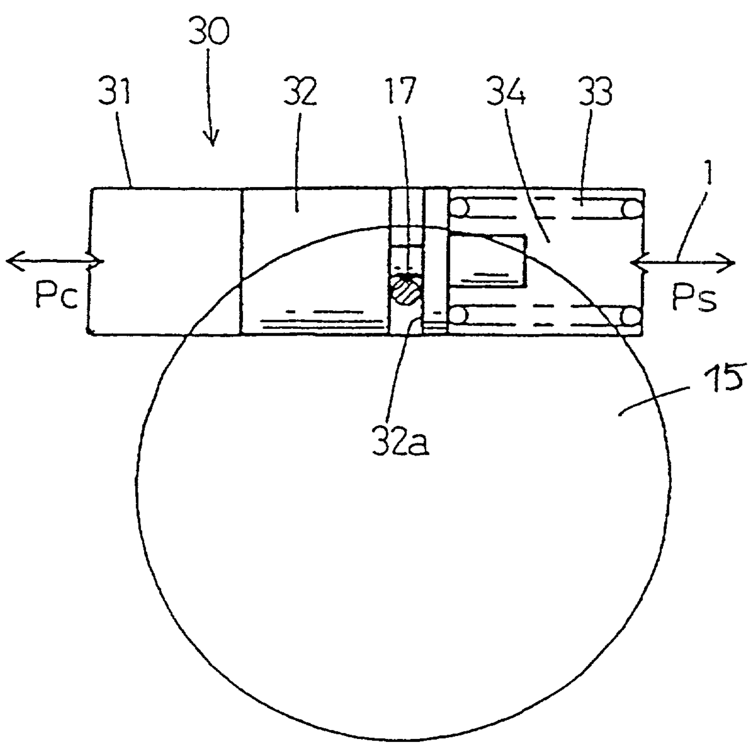
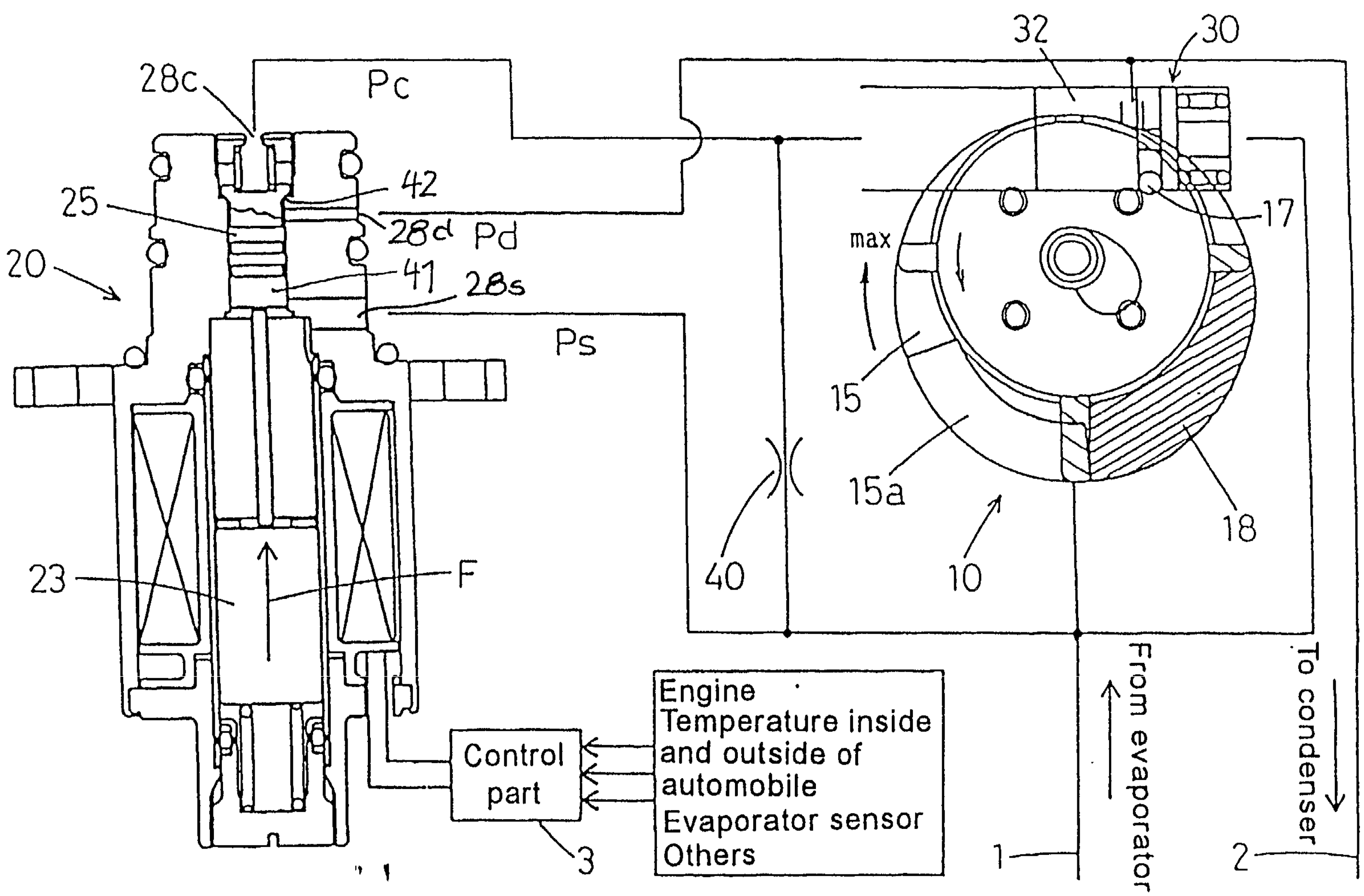


FIG 4

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Pc
42
25
28d
Pd
20
41
28s
Ps
23
F
Control part
3
Engine
Temperature inside and outside of automobile
Evaporator sensor
Others
32
30
17
max
15
15a
40
10
18
1
2
From evaporator
To condenser

FIG 5

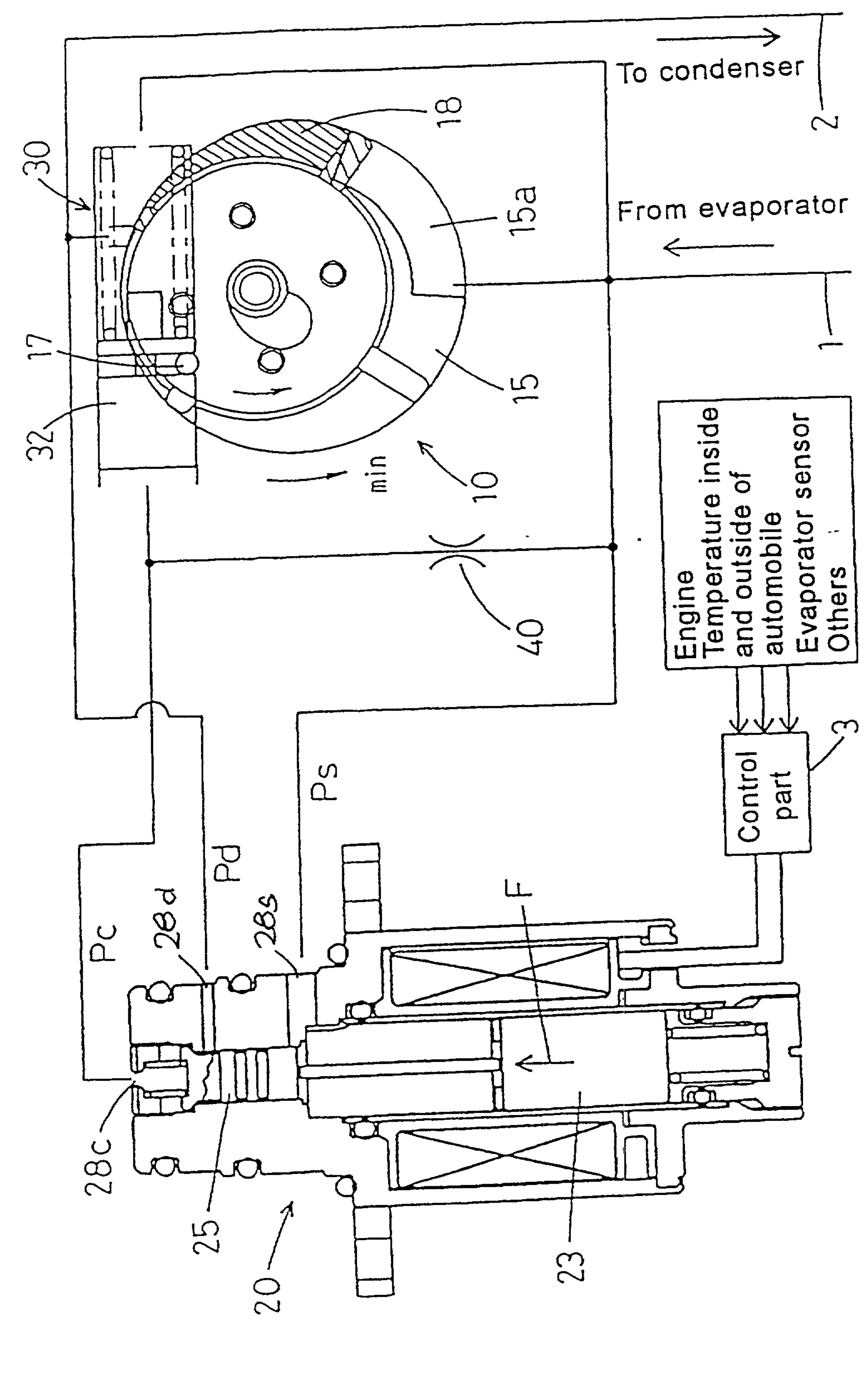
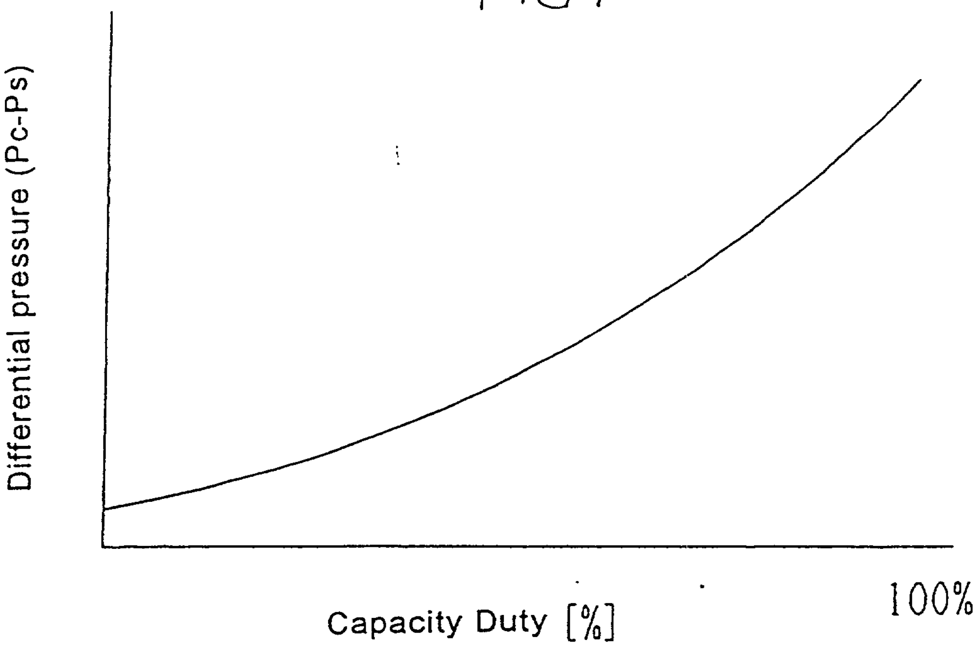

To condenser
From evaporator
2
1
18
15a
15
10
min
30
17
32
40
Engine
Temperature inside and outside of automobile
Evaporator sensor
Others
Control part
3
Ps
Pd
Pc
28d
28s
28c
25
20
23
F

FIG 6

FIG 7



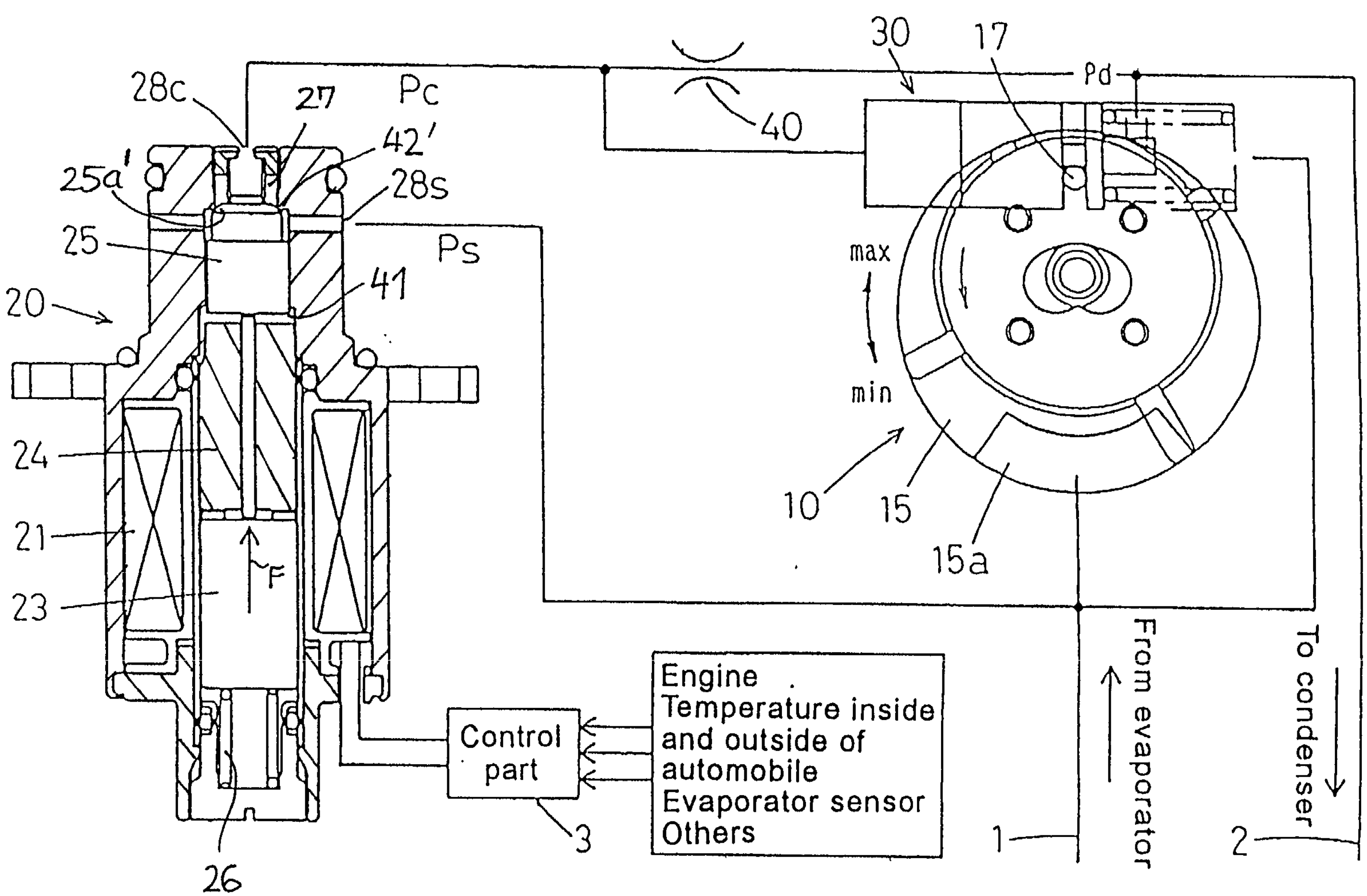

28c
27
Pc
42'
25a'
28s
25
Ps
20
41
24
21
23
26
F
Control part
3
Engine
Temperature inside and outside of automobile
Evaporator sensor
Others
40
30
17
Pd
max
min
10
15
15a
From evaporator
To condenser
1
2

FIG 8

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION
(37 CFR 1.63)

☐ Declaration Submitted with Initial Filing
OR
☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16(e)) required)

Attorney Docket Number: 133.046
First Named Inventor: Hisatoshi HIROTA
COMPLETE IF KNOWN
Application Number: ____________________
Filing Date: ____________________
Group Art Unit: ____________________
Examiner Name: ____________________

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CAPACITY CONTROLLER OF CAPACITY VARIABLE COMPRESSOR

the specification of which
☑ is attached
OR
☐ was filed on ____________________ as United States Application Number or PCT International Application Number ____________________ and was amended on ____________________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s) (Number)	(Country)	(Month/Day/Year Filed)	Priority Not Claimed	Certified Copy Attached?
Hei 11-113035	Japan	21 April 1999	☐	☐ Yes ☑ No
			☐	☐ Yes ☐ No
			☐	☐ Yes ☐ No

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

(Application Number)	(Month/Day/Year Filed)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

DECLARATION – Utility or Design Patent Application

Inventor: Hisatoshi HIROTA
Title: *Capacity Controller of Capacity Variable Compressor*

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to the patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Application(s)

(Number)	(Month/Day/Year Filed)	(Patent Number (if applicable))
(Number)	(Month/Day/Year Filed)	(Patent Number (if applicable))

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

James E. Nilles, Reg. No. 16,663
Andrew J. Nilles, Reg. No. 31,786
Jay G. Durst, Reg. No. 41,723
Lisa M. Gehrke, Reg. No. 38,888
Thaddeus C. Stankowski, Reg. No. P45,522
Matthew C. Loppnow, Reg. No. 45,314
Stephen Michael Patton, Reg. No. 36,235
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Direct all telephone calls to James E. Nilles at telephone number (414) 276-0977, facsimile number (414) 276-0982.
Direct all correspondence to: James J. Nilles
NILLES & NILLES, S.C.
Firstar Center, Suite 2000
777 East Wisconsin Avenue
Milwaukee, Wisconsin 53202-5345

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of Sole or First Inventor ☐ A petition has been filed for this unsigned inventor

Given Name (first & middle [if any]) & Family Name/Surname: **Hisatoshi HIROTA**

Inventor's Signature: ______________________ Date: ____________

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